

STANDARD OPERATING PROCEDURE FOR COLLECTION OF PHYTOPLANKTON SAMPLES DURING HARMFUL ALGAL BLOOMS

State of Utah
Department of Environmental Quality
Division of Water Quality

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Utah Division of Water Quality (DWQ) Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical experts. The primary purpose of this document is for internal DWQ use. This SOP should not replace any official published methods.

Any reference within this document to specific equipment, manufacturers, or supplies is only for descriptive purposes and does not constitute an endorsement of a particular product or service by the author or by DWQ. Additionally, any distribution of this SOP does not constitute an endorsement of a particular procedure or method.

Although DWQ will follow this SOP in most instances, there may be instances in which DWQ will use an alternative methodology, procedure, or process.

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1. SCOPE AND APPLICABILITY

This document presents the Utah Division of Water Quality's (DWQ) Standard Operating Procedure (SOP) for collecting phytoplankton samples during harmful algal blooms (HAB). HABs can occur when cyanobacteria, a type of phytoplankton, become abundant enough to change the visual and physical nature of the waterbody. Although technically inaccurate, the terms "algae" and "algal" are commonly used to refer to both algae and cyanobacteria. Most water protection agencies have adopted the term "harmful algal bloom" to describe these events, and for consistency, DWQ will use the same terminology.

This SOP applies to any DWQ monitor and is recommended as the procedure for the non-DWQ cooperator or local health department (LHD) official performing algal bloom sampling in lakes, reservoirs, rivers, or streams. Any deviations from this procedure should be documented on the sample tracking (Appendix 2) and bloom report (Appendix 3) forms prior to sample submission to the lab. The goal of this sampling is to provide results that may be used: 1) to provide LHDs with information to evaluate potential recreational health risks, 2) provide public water systems with information to evaluate potential risks to drinking water supplies, and 3) for DWQ to record bloom conditions for use in evaluating lake water quality.

Phytoplankton sampling for HAB monitoring programs and health responses is used to detect, identify and quantify cyanobacteria in the water that are potentially toxic to humans and animals. The primary purpose of the sampling is to characterize the nature of the bloom in the context of plausible exposure pathways, especially those with potential to harm people and pets. Therefore, samples should target areas where there is the highest likelihood or risk of human-cyanotoxin interaction and exposure. This may require some planning to determine common use areas such as beaches, piers, shoreline access areas, drinking water intakes, etc. and wind direction, as blooms may be blown to the downwind side of the lake. This information will inform partner agencies whether to take further actions according to their respective response plans.

2. SUMMARY OF METHOD

Phytoplankton samples can be collected from the water column or from the surface depending on the type or phase of the bloom. Cyanobacteria blooms often exhibit extensive temporal and spatial variation. As a result, it may be necessary to take several samples from various places around the lake to accurately estimate the threat of the bloom to humans, pets or livestock. There are several factors that should be considered when selecting sample locations and technique. Samples should be collected in areas of the lake where there is evidence of a potential bloom at the time of sample collection. Within the area of the bloom, samples should be collected where potential exposure is greatest. In many cases, this means samples should be collected near the shorelines where cyanobacteria cells accumulate, especially in areas that are frequented by recreationists. In addition to targeting potential recreational exposure areas, additional samples should be collected across the extent of the bloom so that the

spatial extent of the bloom can be characterized, especially if the waterbody is a drinking water supply. The drinking water intake is typically located in areas where public access is limited and may require a watercraft collection if the bloom is inaccessible from the shore. Visual estimates, documented by taking photographs and GPS coordinates, can also be used to determine the extent of the bloom. Samples are kept in the dark and on ice until they can be refrigerated.

3. ACRONYMS

HAB	Harmful algal bloom
LHD	Local Health Department
m	meter(s)
mL	milliliter(s)
l	Liter
UDEQ	Utah Department of Environmental Quality
MLID	Monitoring Location ID
DWQ	Division of Water Quality
SOP	Standard Operating Procedures

4. HEALTH AND SAFETY WARNINGS

Algal blooms may contain toxin-producing cyanobacteria. Samplers should wear elbow/shoulder length gloves, eye protection (such as goggles), and waders/boots during sampling. Do not ingest water or allow the water to come into contact with exposed skin. Avoid inhaling spray caused by boats, wind or other water surface disturbances. If these conditions are present, wear a mask to avoid inhalation of water spray. Hands should be washed thoroughly after sampling before eating or drinking. Waders/boots should be rinsed of algal material using fresh water (not lake water) before storage.

It is important that monitors also watch for and report any symptoms of exposure to cyanotoxins, which can occur immediately to several days following exposure. Potential symptoms include:

- Liver toxicity – may take hours or days for symptoms to appear in animals and humans; they include abdominal pain, diarrhea, and vomiting.
- Kidney toxicity – acute, severe gastroenteritis (including diarrhea and vomiting).
- Neurotoxicity – often appear within 15 to 20 minutes of exposure; animals may experience increased salivation, weakness, staggering, convulsions, difficulty breathing, and in severe cases, death. Humans may experience numb lips, tingling fingers and toes, or dizziness.
- Respiratory problems – runny eyes and nose, sore throat, and asthma-like symptoms.

- Skin irritation – visible rash, hives, or blisters, especially under clothing, swimsuits, or wetsuit.

If any of these symptoms occur, monitors should seek medical treatment immediately.

Field personnel should take appropriate precautions when operating watercraft and working on, in, or around water. All boats should be equipped with safety equipment such as personal flotation devices (PFDs), oars, air horn, etc. Utah's Boating Laws and Rules shall be followed by all field personnel.

Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, the sample visit is recommended to be rescheduled. If hazardous weather conditions arise during sampling, such as lightning or high winds, personnel should cease sampling and move to a safe location.

5. SAMPLE CAUTIONS AND INTERFERENCES

Care should be taken not to include lake bottom materials that may be disturbed and suspended if wading.

Anything that makes phytoplankton more difficult to visualize in the laboratory can cause interference with results. Try to minimize duckweed, filamentous algae, sediment, etc. in the sample.

High turbidity or dense aquatic vegetation may also interfere with sample collection.

Samples should not be frozen nor exposed to hot temperatures during storage (i.e., do not store in a hot vehicle outside of a cooler).

6. PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

Monitors collecting phytoplankton samples must read this SOP annually and acknowledge they have done so via a signature page (see **Appendix 3**). New field personnel must also demonstrate successful performance of the method. The signature page will be signed by both trainee and trainer to confirm that training was successfully completed and that the new monitor is competent in carrying out this SOP. The signature page will be kept on-file at DWQ along with the official hard copy of this SOP.

7. EQUIPMENT AND SUPPLIES

____ Copy of this SOP

____ Protective equipment: extended gloves, safety goggles, mask, chest/hip waders, and PFD

____ Several clean, plastic 1L sample bottles. The State Lab provides these bottles. Alternatively, a new, unused jug of deionized/distilled/RO water could be used for

sample collection. Open the bottle, pour out the contents, and rinse the bottle with native water before using.

- ____ Several clean, plastic ½ gallon sample bottles for composite samples
- ____ Clean 1 gallon or greater bucket for compositing samples
- ____ 1 clean stirring rod
- ____ Digital camera
- ____ GPS
- ____ Pencils and sharpies
- ____ Sample labels
- ____ Phytoplankton sample labels (**Figure 1**)
- ____ Sample tracking forms (**Appendix 2**)
- ____ Bloom Report Form (**Appendix 3**)
- ____ Field notebook or field form
- ____ Cooler and wet ice or ice packs

Figure 1. Sample label (U:\PERMITS\MONITORS\Labels\HAB-PHYTO-CYANO(5163or5523).doc)

<u>Harmful Algal Bloom Phytoplankton Sample</u>	
Waterbody Name: _____	
Site Description: _____	

Sample Type (1, 2, 3, or 4): _____	
MLID: _____	Bloom Observed? _____
Samplers: _____ Date: _____ Time: _____	

8. PROCEDURE

Due to the varied nature of HABs, contact the DWQ HAB Coordinator, Ben Holcomb (bholcomb@utah.gov, 801.536.4373) or Jodi Gardberg (jgardberg@utah.gov, 801.536.4372) prior to any sample collection to coordinate efforts and to identify sample types, quantity, and locations.

Coordination with DWQ is recommended for the following reasons:

1. Determine and characterize the algal bloom—Is this a potential HAB?

2. Determine the stage of the bloom—Has a cyanobacteria surface scum developed on the waterbody?
3. Determine the spatial extent of the bloom—Is the bloom widespread throughout the waterbody or limited to certain areas?
4. Determine the drinking water and recreational uses of the waterbody.
5. Determine adequate funding is available to cover phytoplankton sampling costs until completion of the bloom. Cooperators and partners should not assume that DWQ will pay for phytoplankton sampling without prior notice and coordination.

To help answer these questions, a visual assessment of the bloom should be conducted prior to contacting the DWQ and sample collection. A visual assessment includes documenting the color and physical nature of the bloom (e.g., floating scum/mats) using a digital camera (**please take photos both close-up and of the extent of the bloom**). Also, note the locations and extent of the bloom, especially if it is present near any public access. Your observations should be recorded on the Algal Bloom Report Form (Appendix 2) and emailed to DWQ's HAB coordinator.

Depending upon the factors identified above, the following 4 types of samples could be collected:

- Type 1: Surface grab – Near-shore (where surface scum has formed)
- Type 2: Surface grab – Open water (where surface scum has formed)
- Type 3: Composite – Near-shore
- Type 4: Composite – Open water

Table 1 should be used to help guide which sample types to collect based upon the waterbody uses and potential exposure.

Table 1. Summary of sample types appropriate for varying exposure scenarios in waters that form harmful algal blooms

Water Use with Exposure Risk	Type 1	Type 2	Type 3	Type 4
Drinking water	X	X	X	X
Swimming beach with surface scum	X		X	
Water skiing		X		X
Pets on shore	X		X	
Boat Launch	X		X	
Boating/Swimming-open water		X		X

Preparing for Sample Collection

Prior to any sample collection, follow these initial steps:

1. Upon arrival at the waterbody, check the GPS coordinates to locate the predetermined area. Please note that this coordinate point is a recommendation and should not supersede the current, ground-based information. Use your

judgement to identify the area(s) where the public has access such as beaches, piers, docks, etc., and where the bloom is concentrated. Take note of wind direction and whether the bloom has blown across the lake to another public access point. If so, collect the sample from that location. If no coordinates are given, or if the sample location changes, ensure that GPS coordinates are collected from the shoreline at the first sampling point and record them. If the sample is collected by watercraft, collect GPS coordinates from the sample location.

2. Use appropriate personal protective gear such as gloves, eye protection, mask, waders/ boots, etc. that will minimize exposures to contaminated water.
3. Label the sample bottle with the sampling location, sample type, date and time of collection (Figure 1).

Surface Grab Sample Procedures (Types 1 and 2)

If the bloom contains a concentrated algal mat or scum on the surface of the water, perform a simple, surface grab sample from the center of the bloom with a 1 liter bottle. This entails tilting the bottle parallel to the water surface with the goal of capturing only the top 1-2 inches of the surrounding surface water/scum. For thick mats, you may need to help push the material into the bottle. Several of these samples may be collected around the near-shore (Type 1) and within the lake by boat (Type 2) to target bloom/interaction risks. The precise locations of these samples may be determined by the bloom extent and water uses for that particular waterbody.

Composite Sample Procedures (Types 3 and 4)

In addition or alternative to the surface grab sample described above, a composite of elbow-depth-to-surface sample may be needed. This procedure requires the collection of three grab samples from elbow-depth to the surface in 1 liter bottles. These triplicate samples will be composited into a ½ gallon sample bottle for analysis. This sample type may be collected near-shore (Type 3) and the open water by watercraft (Type 4). The following procedure should be followed:

1. For the Type 3 sample, carefully wade into the waterbody until knee deep.
2. Remove the lid of the sample bottle and carefully dip the inverted bottle beneath the surface of the water to elbow depth and revert the bottle and bring to the surface, evenly sampling as much of the water column as possible. Replace the lid and move to the next sample point.
3. Walk 10 feet in one direction (paralleling the shoreline) to grab the second replicate; then walk another 10 feet further to grab the third replicate sample. Take extra care when paralleling the shoreline to minimize disturbance of the bottom sediments (i.e. do not sample the kicked up sediment plume). In some cases, this may require walking back to the shore before pacing the 10 steps and then back out to knee depth.

4. Return to shore and composite the three samples in a bucket, mix the samples using a clean stirring rod, and then fill a ½ gallon plastic collection bottle leaving a small headspace.

Type 4 samples follow the same procedure except only performed in a watercraft. The watercraft may simply drift in the lake while the triplicates are collected so that samples are collected apart from another. The precise locations of these samples may be determined by the water uses for that particular waterbody.

Sample Storage and Reporting

Upon the completion of any sample collection, follow these procedures:

1. Store the samples in a cooler on wet ice or ice packs.
2. For each sample, fill out a bloom report form (**Appendix 2**) accurately and completely.
3. If samples are to be delivered to the lab (Section 9), fill out a Chain of Custody form (**Appendix 1**). Samples must be kept in the cooler on wet ice, or otherwise refrigerated in dark conditions until delivery to the lab for analysis.

9. LABORATORY ANALYTICAL METHODS

Phytoplankton samples will be analyzed within 48 hours of collection. Samples will be analyzed quantitatively for community composition. This involves the direct observation and enumeration of the dominant algae and any cyanobacteria present in the water column sampled. Species are identified to the lowest possible taxonomic category (generally species) and counted. Cell density for all identified cyanobacteria *sp.* will be calculated. The methodology and quality assurance and quality control procedures for this analysis and analyzing laboratory can be obtained from:

Sarah Rushforth, MS
Rushforth Phycology, LLC
470 24th Street or 4123 Bona Villa Drive
Ogden, UT
(801) 376-3516
sarah@rushforthphycology.com
<http://rushforthphycology.com/201.html>

10. DATA AND RECORDS MANAGEMENT

Fill out the bloom report form accurately and completely. Make sure information on the field sheet is consistent with the information on the sample container label.

11. REFERENCES

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Graham, J.L., Loftin, K.A., Ziegler, A.C., and M.T. Meyer. 2008. Cyanobacteria in lakes and reservoirs: Toxin and taste-and-odor sampling guidelines. In: National Field Manual for the Collection of Water-Quality Data. Available at: <http://pubs.water.usgs.gov/twri9A7/>

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Ohio DOH, EPA, and DNR. 2015. State of Ohio Harmful Algal Bloom Response Strategy for Recreational Waters. Available at: <http://epa.ohio.gov/portals/35/hab/HABResponseStrategy.pdf>

Oregon Health Authority. Oregon Harmful Algae Bloom Surveillance (HABS) Program. Public Health Advisory Guidelines. Available at: www.healthoregon.org/hab

Proceedings of the interagency, International Symposium on Cyanobacterial Harmful Algal Blooms (ISOC-HAB): State of the Science and Research Needs. Available at:
www.cdph.ca.gov/HealthInfo/environhealth/water/Documents/BGA/ISOCHABdocument.pdf

APPENDICES

Appendix 1 – Chain Of Custody form for phytoplankton samples analyzed by Rushforth Phycology

UTAH DIVISION OF WATER QUALITY					Harmful Algal Bloom - CYANO CHAIN OF CUSTODY RECORD (Rushforth Phycology, LLC)		
PROJECT:					Sample Collection Method: Grab Sample		Preservation: Refrigerated
Sample Date Range:							Analysis Requested: Quantitative Cyanobacteria ID
Sample Number	Sample Type*	Date Collected	Time Collected	MLID or Lat/Long	Site Name	Collector Initials	Notes
	Relinquished By:				Date:	Time:	REMARKS:
	Received By:				Date:	Time:	

*Type 1 =Surface scum – Near-shore; Type 2 = Surface scum – Open water; Type 3: Composite – Near-shore; Type 4: Composite – Open water

Appendix 2 – Bloom Report Form

UT DWQ Algal Bloom Report Form

Please provide information about the potential blue-green algae bloom observed.

Please remember to include digital photographs as additional documentation (close-up, and landscape showing extent and location of bloom). Also, if you don't have ability to collect GPS coordinates, please include an image from an online mapping application such as Google, Bing or Yahoo Maps, with a marker at the bloom location.

Bloom Location:

Waterbody:	Date bloom observed: / /
County (optional):	Drinking Water Source? Yes No Unknown
Publicly Owned Lake? Yes No Uncertain	Attached map with bloom location noted (e.g. Google Map image)? Yes No Digital photos attached? Yes No

Report Completed By:

Name:	Organization:
Title:	Phone: () Email:

Bloom Description and Sampling Information:

Please describe the location of the bloom in the water body (e.g. center of lake, at the boat dock, at the beach):

Do you notice any colors in the water column? Yes No
 Please check any colors you see, or describe the color(s) below:
 Green Blue Red Rust Brown Milky White Purple Black
 Other:

Please estimate the size (sq. feet) or the extent of bloom (e.g., percent of lake):

Can you see a surface scum (an accumulation at the surface) or algae floating near the water surface?
 Algae floating at the surface can look like grass clippings, green cottage cheese curds, or spilled paint.
 Yes No Uncertain

Is the bloom near a public beach? If yes, please specify the beach name or location:
 Yes No Uncertain

Is the bloom near a drinking water intake? (Specify water system name if known):
 Yes No Uncertain

Were samples taken? Yes No
 If yes, what type of samples? *
 Type 1 Type 2 Type 3 Type 4
 When and where were they collected; and where were they sent for analysis?

Do you know if other water quality information is available? (Specify what data is available and where): Yes
 No

Please provide additional observations if available e.g., smells, dead fish/birds, public witness accounts and contact info:

*Type 1 =Surface scum – Near-shore; Type 2 = Surface scum – Open water; Type 3: Composite – Near-shore;
 Type 4: Composite – Open water

Appendix 3 - SOP Acknowledgment and Training Form (front and back)

SOP Acknowledgement and Training Form

This SOP must be read and this form signed annually. This form must be kept with the current version of the SOP.

Document Title:	
Document Revision Number:	
Document Revision Date:	

Please sign below in accordance with the following statement: "I have read and understood the above referenced document. I agree to perform the procedures described in this SOP in accordance with the document until such time that it is superseded by a more recent approved revision."

Printed Name	Signature	Date

Trainer: Sign below to acknowledge that training on this SOP was completed for the individual listed and that trainee is competent to perform the procedures described within.

[illegible]